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G. K. W. BOESTAD ET AL

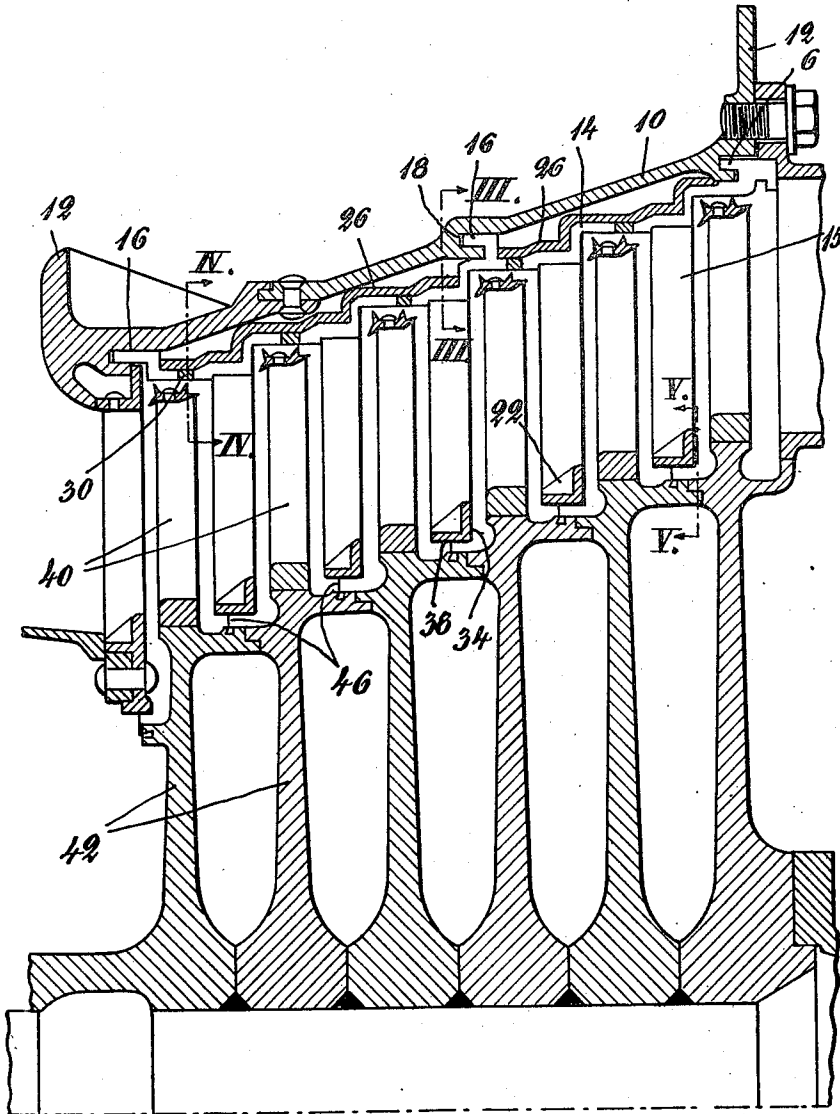
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TURBINE CASING CONSTRUCTION

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Fig. 1.

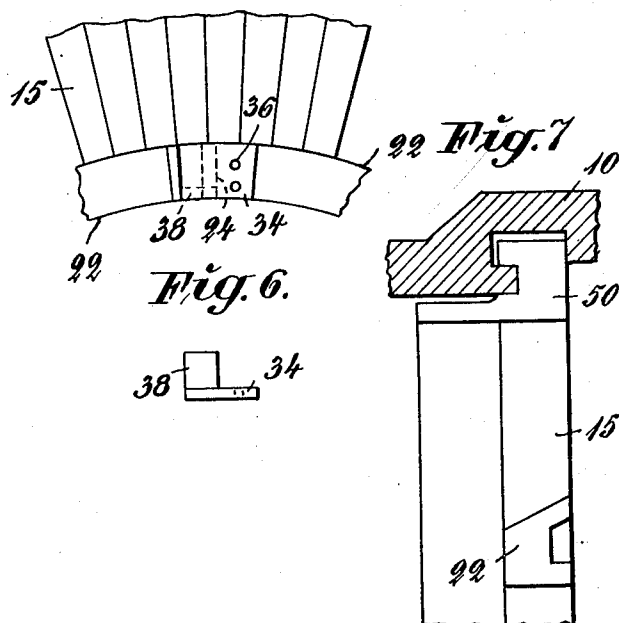


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TURBINE CASING CONSTRUCTION

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Our invention relates to elastic fluid turbines for high temperature motive fluids, and has particular reference to turbines with one or more annular elements in the form of an internal casing, drum or guide blade ring, which supports the guide blades and which bears on guide surfaces of an external casing so as to be centered by the latter.

When the turbine is started or shut off, as well as during operation, differences in temperature will occur between the annular element or elements and the external casing. The differences in temperature, which may be considerable, are caused, for instance, by the external casing being cooled more effectively than the annular elements, or by the dimensions of the external casing being greater than those of the annular elements. In known constructions, these differences in temperature may cause deformation both of the annular element or the internal casing and of the external casing. For this reason it has been proposed to make the guides between the two casings with radial play or clearance of the magnitude required by said differences. Then, however, it cannot be certain that the internal casing actually maintains its desired circular form, among other things because of warping, nor will the internal casing always be properly centered. The result of this is that greater clearance must be provided between the turbine blades and the internal casing than would otherwise be necessary. Nor is it possible to fix the position of the internal casing with the aid of radial pins, since these have no centering effect on the internal casing, especially not on its walls adjacent to the joints of the casing.

The invention has for its general object to eliminate such deficiencies and to maintain the guide blade rows in their proper position, even where great differences in temperature occur between the external casing and the annular elements. A further object of the invention is to provide a turbine, in which the external casing is made with small radial clearance of a magnitude, for instance, of 0.1 mm. or less.

Further objects and advantages of the invention will be apparent from the following description considered in connection with the accompanying drawings which form a part of this specification, and of which:

Fig. 1 is a partially sectioned plan view of a portion of a steam turbine constructed in accordance with the invention;

Fig. 2 shows a portion of two of the parts constituting the internal casing, with sealing means

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provided therebetween; this figure being a projection viewed in a radial direction from within and outwardly;

Fig. 3 is a fragmentary sectional view on the line III—III of Figs. 1 and 2;

Fig. 4 is a fragmentary sectional view on the line IV—IV of Figs. 1 and 2;

Fig. 5 shows a portion of the divided annular element secured to the inside of the guide blades and provided with sealing means; this figure being a fragmentary elevation on the line V—V of Fig. 1.

Fig. 6 shows the last-mentioned sealing means viewed at right angles to Fig. 5.

Fig. 7 shows a portion of a turbine in longitudinal section according to a different embodiment of the invention. In the embodiments shown in Figs. 1-6, 10 designates an external turbine casing member, which may be composed of two or more parts both in planes extending horizontally through the turbine axis and at right angles thereto. The external casing is rigid against forces tending to force the same out of its circular shape. For this purpose, the external casing is provided with radially projecting rings or flanges 12, or the like. An internal turbine casing or drum 14 having guide blades 15 in a plurality of rows secured thereto is centered in the external casing, for instance by being formed with annular projections 16 providing axially extending flanges, which are guided with very small clearance in corresponding recesses or grooves 18 in the external casing. Preferably, the guide surfaces between the projections 16 and the recesses 18 are cylindrical in shape. The guide surfaces need not extend about the whole of the circumference of the two casings, but may be restricted to a number of points distributed about the circumference. The internal casing member 14 is divided into two or more segmental parts along planes extending longitudinally of the axis of the turbine. Peripheral spaces 20 are provided between the parts of the internal casing 14. Therefore, when the internal casing 14 is heated, for instance, to a higher temperature than that of the external casing 10, the internal casing is permitted to expand by being extended peripherally, while the internal casing maintains its proper radial position at the same time, said position being determined by the guide surfaces between the projections 16 and the recesses 18. The adaptation of the internal casing to the position of the guide surfaces of the external casing is rendered possible by the fact that the internal casing is weaker in the sense of being less rigid than

the external casing so as to accommodate itself to the shape of the latter. Furthermore, the forces opposing the expansion of the internal casing in a peripheral direction are relatively small. The individual parts of the internal casing are kept in their proper peripheral position by means of keys or the like anchored in the external casing, said keys being then placed in such manner, for instance at one point only of every part, so as to permit free expansion of the same.

In the several blade rows, the guide blades 15 are connected to an inner ring 22. In order not to oppose the variations in shape of the internal casing 14, the ring 22 is also constructed in a number of parts round the circumference, preferably in four or more parts, which are separated by spaces 24 permitting a free peripheral movement of the parts relative to each other. Consequently, the divided annular element 22 will not oppose the above-mentioned movement of the internal casing 14, when the latter expands or contracts in a peripheral direction. The deformation otherwise occurring, if the ring 22 should, for instance in starting, reach a temperature such as to tend to assume a radial position other than that corresponding to the position of the casing 10 or 14 and of the guide blades 15 at the temperatures prevailing therein, are thus avoided. A whole ring 22 would, in order to permit of increasing in diameter, move sideways, involving deflection of the guide blades in a lateral direction.

Provided between the guide blades are rotor blades 40 supported by disks 42 rigidly connected to each other. Provided between the disks 42 and the guide blades 15 are sealing members 46 of some known type. The motive fluid passes in a direction from left to right in Fig. 1 through the annular space between the internal casing 14 and the rotor disks 42, and in which space the guide blades 15 and the rotor blades 40 are located.

The spaces 20 between the parts of the internal casing 14 can be made sufficiently tight, for instance by means of longitudinally extending and possibly, transversely extending strips or battens, so that undesirable leakage of the motive fluid will not occur therethrough. This also holds true with respect to the spaces 24 between the parts of the inner guide blade rings 22.

In Figs. 1-4, 26 designates such a batten in the form of a cover plate, which is secured, for instance by means of rivets 28, in one of the parts of the turbine casing 14, and which extends across the space 20 over the adjacent part of the turbine casing. The plate prevents leakage in a radial direction. 30 denotes a cross-bar, which may be secured by means of a rivet 31 in the plate 26, and which is received in a peripheral slot 32 in each end portion of the two parts of the internal turbine casing. The cross-bar 30 fills a portion of the space 20 and prevents leakage of the motive fluid in an axial direction through the space.

Figs. 5 and 6 illustrate a similar arrangement to prevent leakage through the spaces 24 in the divided inner guide blade rings 22. A screening member 34 is secured, for instance by means of rivets 36, in one ring part, and arranged to slide along the other. Extending at right angles from the member 34 is a projection 38 which, the same as the member 34, is received in a recess in the end portions of the ring parts. The members 34, 38 likewise prevent leakage of the motive fluid both axially and radially.

The construction shown in Fig. 7 differs from

the preceding one substantially only by the fact that each row of guide blades 15 has its own ring 50, which consequently is not connected to the ring of the adjacent guide blade row. The guide blade rings 50 made in two or more parts are carried and centered by means of projections and recesses of the external casing in the manner above described. The spaces between the parts of the annular elements may be sealed in a manner similar to that illustrated in Figs. 2-4. The sealing members illustrated therein may, however, be made integral with the internal casing or with the annular elements, in accordance with common practice in piston rings for motors.

While two embodiments of the invention have been shown, it is to be understood that these are for purpose of illustration only, and that the invention is not to be limited thereby, but its scope is to be determined by the appended claims.

What we claim is:

1. An elastic fluid turbine having an external casing and an internal annular member carrying turbine guide blades, said member being divided longitudinally of the turbine to provide a plurality of elements with longitudinally extending clearance spaces therebetween to permit peripheral expansion and contraction of the elements, cooperating guide surfaces on said casing and said elements for centering the latter relative to the casing, said surfaces engaging to restrain the member against radial movement thereof relative to the casing and to cause relative movement between the engaged parts due to differential expansion and contraction to take place peripherally at constant radius and sealing means engaging said elements to close said clearance spaces while permitting relative peripheral movement between adjacent ones of said elements.

2. A turbine as set forth in claim 1 in which said sealing means comprises longitudinally extending plates or battens overlying said clearance spaces and in sliding contact with at least one of the elements adjacent to the clearance space covered thereby.

3. A turbine as set forth in claim 1 in which said sealing means comprises longitudinally extending sealing elements overlying said clearance spaces to prevent radial leakage therethrough and additional sealing elements located in said clearance spaces for preventing leakage axially therefrom.

4. A turbine as set forth in claim 1 in which each element into which said internal member is divided comprises an outer ring segment engaging said casing and an inner ring segment to which the inner ends of the guide blades are secured, there being peripheral clearance between the ends of the inner ring segments and sealing means being provided for preventing leakage between said inner ring segments while permitting relative peripheral movement therebetween.

5. In an elastic fluid turbine, a guide blade system comprising a plurality of inner and outer segmental blade supporting elements, guide blades connecting said elements, an outer relatively rigid casing, said casing and said outer elements having cooperatively engaging guide surfaces for supporting and centering the elements and for permitting relative peripheral movement therebetween by restraining said outer elements against material radial movement relative to said casing, both said inner and outer elements having material clearance in peripheral direction between adjacent edges thereof when the parts are

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cold to permit them to expand peripherally when the parts are heated, said clearances extending longitudinally of the axis of the turbine, and sealing means carried by said elements in sliding engagement therewith for permitting the aforesaid relative peripheral movement between the adjacent parts for closing said clearances.

6. An elastic fluid turbine including an outer casing member having a barrel portion encircling the blade system of the turbine, an annular carrying member for carrying the guide blades of the turbine, said carrying member being substantially less rigid peripherally than the barrel portion of said casing member and being parted along lines extending axially of the turbine to provide a plurality of segmental blade carrying elements, and means for mounting said carrying member in said casing member comprising peripherally extending cooperating flange and groove structure on said members engaging to prevent relative radial movement between said members, the adjacent edges of contiguous ones of said segmental elements being sufficiently spaced from each other peripherally to provide clearance along the lines of partition between said segmental elements when the parts are cold at least as great as the expansion in peripheral direction of the segmental elements relative to the casing member resulting from the differential expansion between said members when the turbine is heated to normal operating temperature and the segmental elements are constrained to expand on a radius determined by the relatively more rigid and cooler outer casing member.

7. A structure as set forth in claim 6, in which said flange and groove structure comprises internal grooves in said casing member opening axially of the casing and external projections on said elements providing flanges extending axially into said grooves.

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8. The structure as set forth in claim 6, in which sealing means carried by said elements in sliding engagement therewith overlie said clearance spaces to prevent leakage therethrough without interfering with the movement of the parts defining the clearance spaces toward and away from each other due to said differential expansion.

9. A structure as set forth in claim 6, in which inner segmental elements having like peripheral clearance between adjacent edges thereof when the parts are cold are provided for supporting the inner ends of the guide blades.

10. A structure as set forth in claim 6, including inner segmental elements for supporting the inner ends of the guide blades and having peripheral clearance between adjacent edges of said inner elements like the first mentioned clearance when the parts are cold, and sealing means carried by said inner elements in sliding engagement therewith, said sealing means overlying the clearance spaces between said inner elements to prevent leakage therethrough without interfering with the movement of the parts defining the clearance spaces toward and away from each other due to said differential expansion.

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